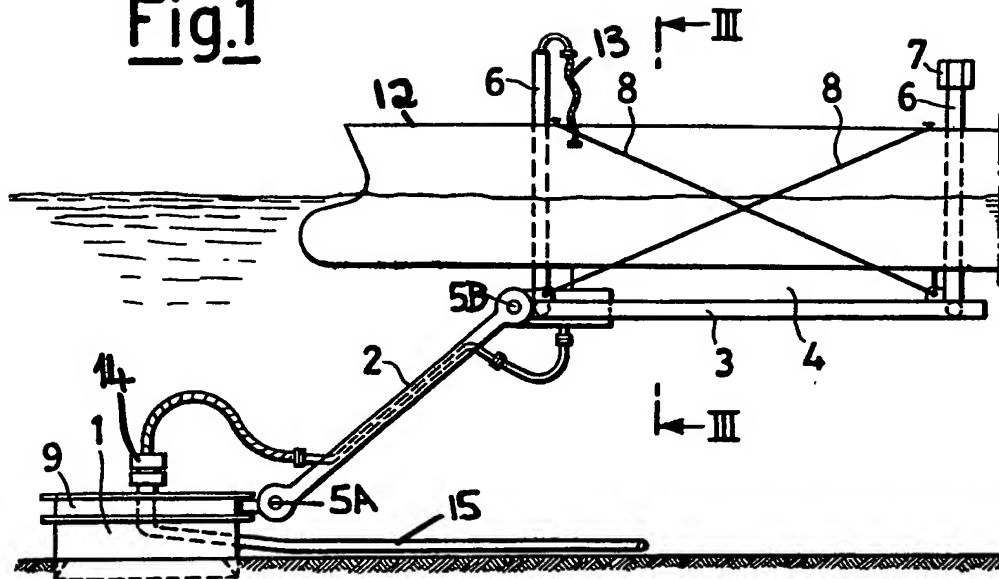
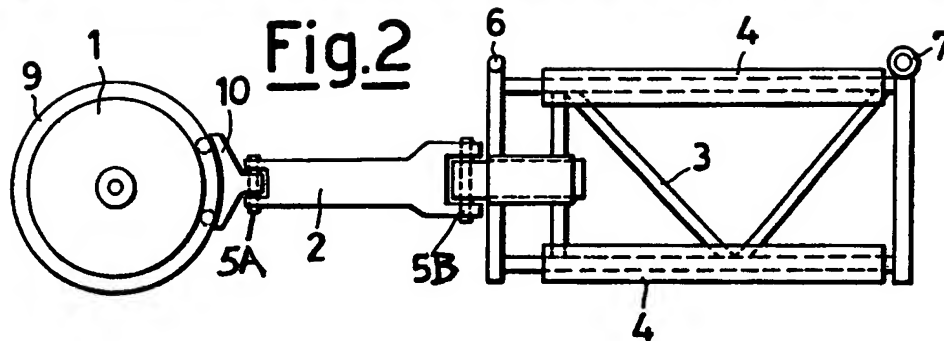
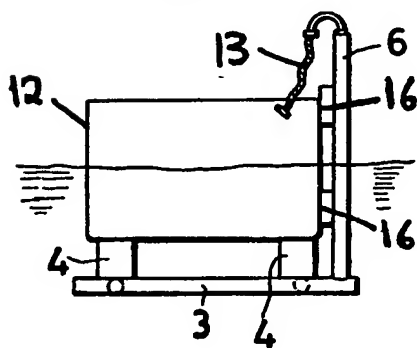
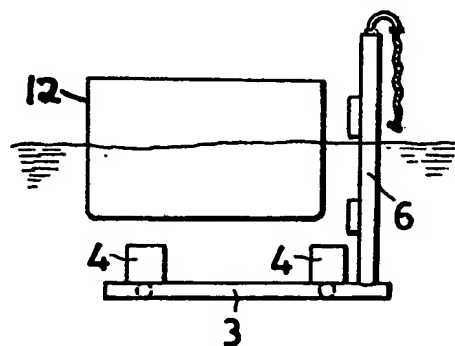


- The hull (12) can be secured near its centre to the frame (3), which minimizes the effect of external forces on the combination of hull (12) and mooring system.



The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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Fig.1Fig.2Fig.3Fig.4

SPECIFICATION

A mooring system for a surface vessel

This invention relates to a mooring system for a surface vessel.

- 5 Various considerations, particularly those relating to tankers while taking on or discharging oil, make it desirable to provide fixed mooring points on certain sea beds.

- 10 According to the present invention there is provided a mooring system for a surface vessel, comprising:

an anchoring member intended to rest on or be fixed to the sea bed;

- 15 an arm one region of which is mounted with respect to the anchoring member in a manner such as to permit rotation of the arm about a vertical axis and pivotal movement of the arm in a vertical plane; and

- 20 a frame for abutting a hull of a surface vessel, the frame being pivotally connected to another region of the arm for relative pivotal movement in a vertical plane;

- the arrangement of the system being such that, in use, the frame may be moved upwardly from an inoperative position to an operative position in which it abuts a hull of a surface vessel which is then secured to the frame, the vessel then being free to adopt that angular position relative to the anchoring member dictated by any external force.

- 30 With the mooring system of the present invention a surface vessel, on completion of the mooring operation, can freely be rotated about the vertical axis, under the influence of an external force; moreover the vessel can be moored in the most appropriate position relative to the centre of the hull, so as to minimize movements due to the action of external forces such as the wind and the waves.

- 40 Preferably, in the mooring system of the present invention, the connections intermediate the anchoring member and the frame are such that a base region of the frame is capable of pitching but incapable of rolling.

- 45 Conveniently the mooring system includes a supporting member mounted on the anchoring member for rotation relative thereto about a vertical axis, and pivotally connected to the one region of the arm to permit pivotal movement of the arm in a vertical plane. The supporting member may be, for instance, an annular member or a non-annular member mounted for movement relative to an annular track disposed about the vertical axis.

- 55 Conveniently the frame is provided with one or more compartments which can be flooded with water or filled with a gas to cause the frame to tend to move downwards or upwards, respectively. It is possible, however, for alternative means to be provided for causing upward and downward movement of the frame.

- 60 In the case in which the frame is provided with the aforementioned compartment, there can also be provided a pump capable of pumping the gas, usually air, into the compartment.

- 65 Preferably the frame is provided with uprights which, in use, can be positioned against the wall of the hull of a vessel. The pump, when present, can be supported at an upper end region of one of the uprights so as to keep it above the level of the sea.

- 70 In the case in which the mooring system is to be used for mooring a tanker, the system can also include a pipeline for conveying a fluid (usually oil or gas) from a region of the frame to a region of the anchoring member. In practice, one end of the pipeline can be connected with a tank on board the tanker, and the opposite end of the pipeline can be connected to a submerged line which lies on, or is buried under, the sea bed.

- 80 Preferably the pipeline is secured to an upper end region of one of the uprights, is secured to the arm, includes a rotational coupling in the region of the anchoring member, and is capable of flexing at least in that region between the frame and the arm and in that region between the arm and the anchoring member.

- 85 In practice, usually only the upper portions of the uprights will project above the level of the sea, thus reducing the area exposed to the action of the wind.

- 90 For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing, in which:

- 95 Figure 1 is a side elevational view of one embodiment of the mooring system of the present invention, with the base of the frame positioned below the hull of a vessel;

- 100 Figure 2 is a plan view from above of the mooring system of Figure 1;

- Figure 3 is a cross-sectional view taken along the line III—III of Figure 1, but showing only the frame and the vessel; and

- 105 Figure 4 is a view similar to Figure 3, but showing the base of the frame slightly below the hull of the vessel.

- The mooring system illustrated in the drawings includes three main components, namely an anchoring member 1, an arm 2, and a frame 3.

- 110 The anchoring member 1 can rest on the sea bed under the action of its own weight, or it can be secured to the sea bed by piles driven in the bed.

- 115 The anchoring member 1 in the illustrated embodiment is a circular cylinder and it has around an upper peripheral region a pair of guide rails 9 which define an annular track, along which a carriage 10 (shown in Figure 2) is free to move. The carriage 10 is thus rotatable about a vertical axis passing through the centre of the anchoring member 1.

- 120 One end region of the arm 2 is pivotally connected by a horizontal pivot 5A to the carriage 10, and the opposite end region of the arm 2 is pivotally connected by a horizontal pivot 5B to one end of the frame 3.

- The arrangement is such that, by virtue of the carriage 10 in the rails 9, the combination of arm

2 and frame 3 is free to undergo rotational movement about the aforementioned vertical axis. In addition, in view of the horizontal pivots 5A and 5B, the frame 3 is capable of being raised and

5 lowered. The illustrated embodiment ensures that the frame 3 does not roll, although it is capable of undergoing a pitching movement. However, efforts are usually made to maintain the base of the frame 3 in a generally horizontal disposition.

10 Mounted on the base of the frame 3 are two spaced-apart buoyancy tanks 4 which are capable of being flooded or filled with compressed air to tend to cause the frame 3 to be lowered or raised, respectively.

15 Shown abutting the tanks 4 is the hull 12 of a vessel, this being shown in Figures 1 and 3.

The frame 3 is also provided with two uprights 6 on top of one of which is a pump 7 for pumping air to the tanks 4, and attached to the other of which is part of a pipeline 13 which leads down the length of that upright 6 and then, via a flexible portion, to the arm 2 and then, by another flexible portion, to a rotatable coupling 14 on the

20 anchoring member 1 and from there to a section 15 lying on the sea bed. Also shown in Figure 1 are mooring lines 8 between the hull 12 of the vessel and the frame 3. As is clear from Figure 3, when the vessel is correctly moored relative to the frame 3, the side wall of the hull 12 abuts abutment zones 16 on the uprights 6.

The mooring frame 3 is of tubular structure but it will be appreciated that any suitable alternative structure could be employed.

35 Also present, but not shown, are valves which allow air (or any other gas) to escape from the tanks 4 so that the tanks can fill with water thereby reducing the buoyancy.

The mode of operation of the mooring system will now be described.

The tanks 4 are at least partially flooded with water to as to cause the frame 3 to sink sufficiently so that the uppermost regions of the tanks 4 are lower than the underside of the hull 12 of a vessel to be moored to the frame 3.

45 The combination of arm 2 and frame 3 can either adopt the position dictated by the external forces (primarily the current), or be moved by a smaller surface vessel, such as a tug, into a direction which suits the line of approach of the tanker. The tanker initially approaches and takes up the relative position to the frame 3 indicated in Figure 4. Then temporary mooring lines between the hull 12 of the tanker and the uprights 6 are used to bring the side wall of the hull 12 into contact with the abutment zones 16. After this compressed air is driven by the pump 7 into the buoyancy tanks 4 so as to expel water therefrom, thereby causing the frame 3 to move upwards until the upper surfaces of the tanks 4 exert an upward force on the underside of the hull 12. At this stage additional securing lines 8 can be made fast between the hull 12 and the frame 3. The arrangement is now as illustrated in Figure 3. The pipeline 13 can be connected to a tank on board

the tanker and, for instance, oil can be transferred via the pipeline 13 to the submerged section 15.

With the mooring system of the present invention, which is economical to construct, the hull can be moored, to the frame, at a position which is appropriately near to the centre of the hull, so as to reduce to a minimum the movements attributable to the waves and the wind. With the illustrated embodiment, only the upper portions of the uprights 6 are exposed to the influence of any wind and, moreover, the uppermost portion of the pipeline 13 should remain clear of the sea.

With a vessel moored to the frame 3, any torque attributable to external forces is converted into rotation about the anchoring member 1.

CLAIMS

1. A mooring system for a surface vessel, comprising:

an anchoring member intended to rest on or be fixed to the sea bed;

an arm one region of which is mounted with respect to the anchoring member in a manner such as to permit rotation of the arm about a vertical axis and pivotal movement of the arm in a vertical plane; and

a frame for abutting a hull of a surface vessel, the frame being pivotally connected to another region of the arm for relative pivotal movement in a vertical plane;

95 the arrangement of the system being such that, in use, the frame may be moved upwardly from an inoperative position to an operative position in which it abuts a hull of a surface vessel which is then secured to the frame, the vessel then being free to adopt that angular position relative to the anchoring member dictated by any external force.

2. A mooring system as claimed in claim 1, wherein the connections intermediate the anchoring member and the frame are such that a base region of the frame is capable of pitching but incapable of rolling.

3. A mooring system as claimed in claim 1 or 2, which also includes a supporting member mounted on the anchoring member for rotation relative thereto about a vertical axis, and pivotally connected to the one region of the arm to permit pivotal movement of the arm in a relative plane.

4. A mooring system as claimed in claim 3, wherein the supporting member is an annular member or non-annular member mounted for movement relative to an annular track disposed about the vertical axis.

5. A mooring system as claimed in any preceding claim, wherein the frame is provided with one or more compartments which can be flooded with water or filled with a gas to cause the frame to tend to move downwards or upwards, respectively.

6. A mooring system as claimed in claim 5, which also includes a pump capable of pumping the gas into the compartment.

7. A mooring system as claimed in any preceding claim, wherein the frame is provided with uprights which, in use, can be positioned

against the wall of the hull of a vessel.

8. A mooring system as claimed in claim 7 when appendant to claim 6, wherein the pump is supported at an upper end region of one of the

5 uprights.

9. A mooring system as claimed in any preceding claim, which also includes a pipeline for conveying a fluid from a region of the frame to a region of the anchoring member.

10 10. A mooring system as claimed in claim 9 when appendant to claim 7 or 8, wherein the pipeline is secured to an upper end region of one of the uprights, is secured to the arm, includes a rotational coupling in the region of the anchoring member, and is capable of flexing at least in that

15 region between the frame and the arm and in that region between the arm and the anchoring member.

20 11. A mooring system as claimed in claim 1, substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawing.

12. A temporary or permanent rotary mooring system for a surface vessel, in which, on

25 completion of the mooring operation, the vessel can freely be rotated about the axis of a central body, under the thrust of an external force.

13. A mooring system according to claim 12, wherein the vessel can be moored in the most appropriate position relative to the centre of the hull so as to minimize the movements due to the action of external forces, such as the wind and the waves.

14. A mooring system according to claim 12 or 13, wherein the system offers minimum resistance to the action of external forces above sea level, said resistance being restricted to the two uprights projecting above the sea level.

15. A mooring system according to claim 12, 13 or 14, wherein a mooring frame can be secured to the vessel by means of cables and the positive upward thrust imparted by buoyancy tanks filled with air by a compressor.